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Jodi A. Calderon

Date: 5-18-01

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Serial No.: 09/769,577
Filing Date: January 25, 2001
Inventor: Johnston, et al.
Assignee: Meggitt (UK) Limited
Invention: *Chemical Reactor*

Examiner: (not yet assigned)
Group Art Unit: 1764
Attorney Docket No. 101.003

PRELIMINARY AMENDMENT

Commissioner of Patents and Trademarks
Washington, DC 20231

Dear Sir:

In advance of examination, Applicants respectfully request that the following amendment be entered.

IN THE SPECIFICATION:

Please amend the following paragraphs as follows:

Paragraph beginning on page 1, line 3:

This application claims priority under 35 U.S.C. §119(e) to U.S. Provisional Patent Application No. 60/184,007 entitled Catalytic Bed Reactor, filed February 22, 2000, and under 35 USC §119(a) to G.B. 0001699.8, filed January 25,

2000 and G.B. 0017187.6, filed July 13, 2000, the entirety of each of which is incorporated herein by reference.

Paragraph beginning on page 7, line 23 through page 8, line 4:

The invention addresses the problems observed in the prior art by adopting the approach of staged adiabatic reactors and improving the performance thereof by design of a reactor comprising a reaction zone and heat exchange means of the plate type in operative contact with the reaction zone so as to receive reactants for heat exchange purposes, wherein the heat exchange means is formed from a plurality of superposed metal plates wherein fluid flow channels have been formed, e.g., by etching, chemical or hydraulic milling, according to a pre-determined pattern, said channel-bearing plates being aligned during superposition to define discrete heat exchange pathways for fluids and diffusion bonded together. The plate exchangers to be adopted are panels made according to an etching, chemically milling or hydraulic cutting technique commonly referred to as printed circuit design since the manner of fluid channel definition and formation frequently adopted is analogous to the manufacture of printed circuit boards.

Paragraph beginning on line 1, page 9:

The invention can also be applied to non-catalytic processes, wherein there may be one or more reactor compartments, bounded by late or PCHE type heat exchangers at the

inlet and/or outlet. Possible embodiments of the reactor may be considered as analogous to the foregoing catalytic reactor descriptions, with suitably dimensioned reactor compartment(s) in place of the catalytic bed(s).

Paragraph beginning on line 5, page 12:

The heat exchanger stack may be formed from a length or block of superposed plates by division e.g. by cutting into individual slices of a desired dimension which enables very slim designs.

IN THE CLAIMS:

Please cancel claims 1-18.

Please add new claims 19-47.

19. (New) A reactor comprising

(a) a reaction zone; and

(b) a heat exchanger in operative contact with the reaction zone so as to receive reactants for heat exchange purposes, wherein the heat exchanger is formed from a heat exchange panel that includes a plurality of superposed metal plates bearing fluid flow channels, the channel-bearing plates being (i) aligned during superposition to define discrete heat exchange pathways for fluids, and (ii) diffusion bonded together.

20. (New) A reactor according to claim 19, wherein the reaction zone comprises at least one catalyst bed.

21. (New) A reactor according to claim 19, wherein the fluid flow channels are formed by chemically etching the channel-bearing plates.

22. (New) A reactor according to claim 19, wherein the fluid flow channels are formed by hydraulically etching the channel-bearing plates.

23. (New) A reactor according to claim 19, wherein multiple heat exchange panels are embedded within the reaction zone, and wherein a contact face area of the panels is generally equal to a contact face area of the reaction zone.

24. (New) A reactor according to claim 19, wherein a plurality of reaction zones are arranged in succession, and wherein a heat exchange panel is arranged between each set of adjacent reaction zones.

25. (New) A reactor according to claim 24, wherein at least three reaction zones are arranged in series.

26. (New) A reactor according to claim 24, wherein the heat exchange panel has a thickness of up to about 100 mm.

27. (New) A reactor according to claim 19, wherein the heat exchange panel includes passages comprising tortuous pathways with one of convolution and zigzags.

28. (New) A reactor according to claim 19, wherein the heat exchange panel comprises a printed circuit heat exchanger type (PCHE) panel.

29. (New) A reactor according to claim 19, wherein the reaction zone comprises a catalyst bed including a variable form catalyst.

30. (New) A reactor according to claim 19, further comprising a screen that restrains catalyst particles from entering the passages of the heat exchanger panel.

31. (New) A process of fluid reactant conversion comprising:

(a) providing a reactor including a reaction zone and a heat exchanger in operative contact with the reaction zone;

(b) providing a fluid reactant species to be converted in the reaction zone at a predetermined stage of reaction;

(c) introducing at least a portion of the fluid reactant species into a discrete reactant fluid pathway within the heat exchanger; and

(d) introducing an auxiliary fluid at a temperature differing from that of the fluid reactant species into another discrete fluid pathway within the heat exchanger and juxtaposed to the reactant fluid pathway, whereby the discrete nature of the respective

pathways permits only indirect heat exchange between the fluid reactant species and the auxiliary fluid.

32. (New) An apparatus for controlling a temperature profile of a reactant fluid in the presence of a catalyst during an endothermic or exothermic chemical reaction, the apparatus comprising:

(a) a reactor having a reactant fluid inlet and reactant fluid outlet;

(b) catalytic beds provided in the reactor between the reactant fluid inlet and the reactant fluid outlet;

(c) a printed circuit heat exchanger (PCHE) that separates two adjacent catalytic beds from one another, the heat exchanger including a heat exchanging fluid inlet, a heat exchanging fluid outlet, a first channel for passage of a heat exchanging fluid, and a second channel in communication with the adjacent catalytic beds to allow passage of a reactant fluid from one catalytic bed to the next, the second channel being fluidically separated from the first channel to maintain separation of the heat exchange fluid and the reactant liquid.

33. (New) An apparatus according to claim 32, wherein different catalysts are provided in separate catalytic beds.

34. (New) An apparatus according to claim 32, wherein the heat exchange fluid is at least one of a molten salt, a molten metal, a hot liquid, a hot gas, a steam, superheated steam, a chilled liquid, a chilled gas, a vaporising fluid and a condensing fluid.

35. (New) An apparatus according to claim 32, further comprising

(a) a catalyst inlet;

(b) a catalyst outlet;

(c) a feeder that feeds catalyst into the catalyst inlet; and

(d) a remover that removes catalyst from the catalyst outlet.

36. (New) A process for indirectly controlling a temperature profile of a reaction fluid in the presence of a catalyst during an endothermic or exothermic chemical reaction, the processing comprising:

(a) passing a reactant fluid from a reactant fluid inlet in a reactor through a first catalytic bed,

(b) then passing the reactant fluid through a first channel in a printed circuit heat exchanger (PCHE);

(b) then passing the reactant fluid through a second catalytic bed;

(c) passing a heat exchanging fluid from a heat exchanging inlet in the PCHE to a heat exchanging outlet through a second channel in the PCHE, the first and second channels being fluidically separated from one another; and

(d) indirectly exchanging heat between the heat exchanging fluid and the reactant fluid in the PCHE.

37. (New) A reactor comprising:

(a) a reactant fluid inlet;

(b) a reactant fluid outlet;

(c) first and second adjacent catalyst beds each including a catalyst;

(d) a heat exchanger arranged between the first and second catalyst beds, the heat exchanger including at least two channels formed therein in fluidic separation from one another, the first channel permitting flow of reactant fluid from the first catalytic bed to the second catalytic bed, and the second channel permitting flow of a heat exchange fluid therethrough.

38. (New) A reactor according to claim 37, wherein the reactor is a moving bed reactor, and wherein a catalyst outlet is provided adjacent a lower end of the catalyst beds such that the catalyst can be urged through the catalyst outlet by gravity and catalyst can be passed through the catalyst inlet.

39. (New) A reactor according to claim 37, wherein the heat exchanger comprises a printed circuit heat exchanger (PCHE).

40. (New) A reactor according to claim 37, further comprising an additional heat exchanger in communication with the reactant fluid inlet, the additional heat exchanger containing pre-heat channels.

41. (New) A reactor according to claim 37, further comprising a fine mesh that covers ends of the channel adjacent the catalytic beds.

42. (New) A reactor according to claim 37, wherein the heat exchanger is formed from plates, the plates being diffusion bonded together.

43. (New) A reactor according to claim 37, wherein the heat exchanger includes passages comprising tortuous pathways with at least one of convolutions and zigzags.

44. (New) A method of making a reactor, comprising:

(a) providing a reactor shell having a reaction zone disposed therein;

(b) making a heat exchange panel by

1) superpositioning metal plates such that surface structures on the metal plates form fluid flow channels between adjacent metal plates, and

2) diffusion bonding the metal plates together; and

(c) positioning the heat exchange panel in the reactor shell in operative contact with the reaction zone so as to receive reactants and auxiliary fluids for indirect heat exchange purposes.

45. (New) A method according to claim 44, wherein the fluid flow channels are formed by chemically etching the surfaces of the plates.

46. (New) A method according to claim 44, wherein the fluid flow channels are formed by hydraulically etching the surfaces of the plates.

47. (New) A method according to claim 44, wherein the heat exchange panel comprises a printed circuit heat exchanger type (PCHE) panel.

REMARKS

Entry of the amendments is respectfully requested. The specification has been amended to correct a typographical error in the claim for priority and other minor errors noted upon a review thereof. Claims 1-18 have been canceled. New claims 19-47 have been added, without narrowing the claims and for purposes unrelated to patentability, in order to place the claims into conformance with preferred USPTO practice. Claims 19-47 are pending in the application.

CONCLUSION

A check for $402 is enclosed in payment of the fee associated with 1) the submission of nine additional claims in excess of twenty ($162) and 2) the submission of three additional independent claim in excess of three ($240) by a large entity. No other fees are believed to be payable with this communication. Nevertheless, should the Examiner consider any other fees to be payable in conjunction with this or any future communication, the Director is authorized to direct payment of such fees, or credit any overpayment to Deposit Account No. 50-1170.

The application is now ready for examination on the merits. Early notification of such action is earnestly solicited.

Respectfully submitted,

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Dated: May 18, 2001

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VERSION WITH MARKINGS TO SHOW CHANGES MADE

Amended Specification Paragraphs

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